

Geometry Date_____ 1.2 Notes

Points, Lines, and Planes (pp 10–12)

A **definition** uses known words to describe a new word. In geometry, some words, such as *point*, *line*, and *plane*, are **undefined terms**. Although these words are not formally defined, it is important to have general agreement about what each word means.

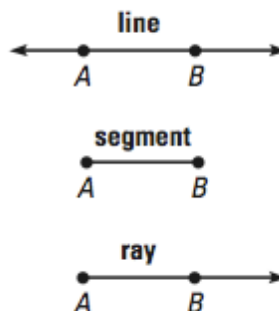
A **point** has no dimension. It is usually represented by a small dot.

A **line** extends in one dimension. It is usually represented by a straight line with two arrowheads to indicate that the line extends without end in two directions. In this book, lines are always straight lines.

A **plane** extends in two dimensions. It is usually represented by a shape that looks like a tabletop or wall. You must imagine that the plane extends without end, even though the drawing of a plane appears to have edges.

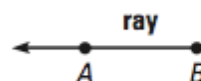
Another undefined concept in geometry is the idea that a point on a line is *between* two other points on the line. You can use this idea to define other important terms in geometry.

Consider the **line** AB (symbolized by \overleftrightarrow{AB}).
The **line segment** or **segment** AB (symbolized by \overline{AB}) consists of the **endpoints** A and B , and all points on \overleftrightarrow{AB} that are between A and B .

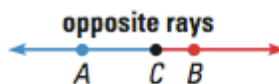


The **ray** AB (symbolized by \overrightarrow{AB}) consists of the **initial point** A and all points on \overleftrightarrow{AB} that lie on the same side of A as point B .

Note that \overleftrightarrow{AB} is the same as \overleftrightarrow{BA} , and \overline{AB} is the same as \overline{BA} . However, \overrightarrow{AB} and \overrightarrow{BA} are *not* the same. They have different initial points and extend in different directions.



If C is between A and B , then \overrightarrow{CA} and \overrightarrow{CB} are **opposite rays**.



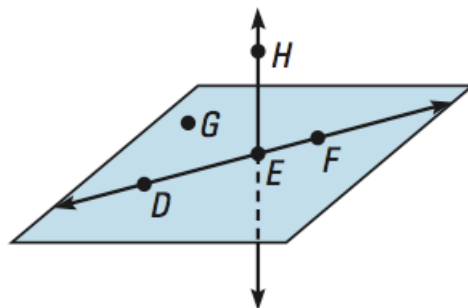
Like points, segments and rays are collinear if they lie on the same line. So, any two opposite rays are collinear. Segments, rays, and lines are coplanar if they lie on the same plane.

Two or more geometric figures **intersect** if they have one or more points in common. The **intersection** of the figures is the set of points the figures have in common.

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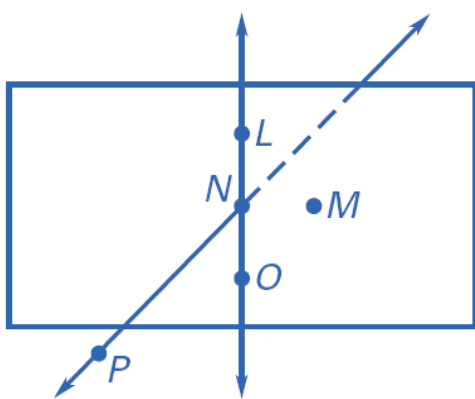
EXAMPLE 1 *Naming Collinear and Coplanar Points*

- a. Name three points that are collinear.
- b. Name four points that are coplanar.
- c. Name three points that are not collinear.



SOLUTION

- a. Points D , E , and F lie on the same line, so they are collinear.
- b. Points D , E , F , and G lie on the same plane, so they are coplanar. Also, D , E , F , and H are coplanar, although the plane containing them is not drawn.
- c. There are many correct answers. For instance, points H , E , and G do not lie on the same line.



- 1. Name four points that are coplanar.
- 2. Name four points that are not coplanar.
- 3. Name three points that are collinear.

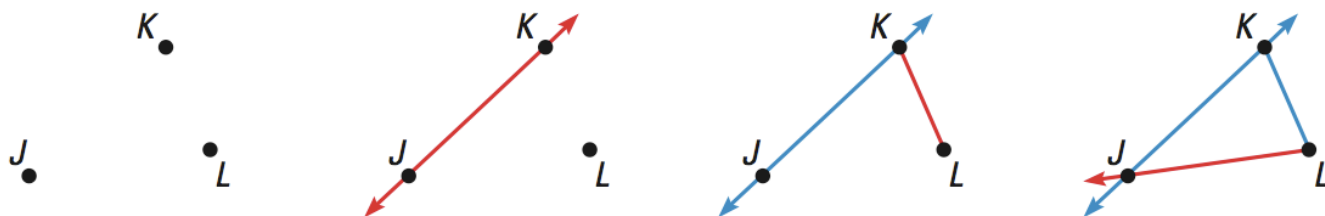
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EXAMPLE 2 Drawing Lines, Segments, and Rays

Draw three noncollinear points, J , K , and L . Then draw \overleftrightarrow{JK} , \overline{KL} and \overrightarrow{LJ} .

SOLUTION



- 1 Draw J , K , and L .
- 2 Draw \overleftrightarrow{JK} .
- 3 Draw \overline{KL} .
- 4 Draw \overrightarrow{LJ} .

4. Draw three collinear points A , B , and C . Draw point D which is not collinear with A , B , and C . Draw \overline{AB} and \overline{BD} .

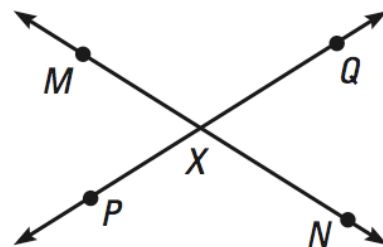
EXAMPLE 3 Drawing Opposite Rays

Draw two lines. Label points on the lines and name two pairs of opposite rays.

SOLUTION

Points M , N , and X are collinear and X is between M and N . So, \overrightarrow{XM} and \overrightarrow{XN} are opposite rays.

Points P , Q , and X are collinear and X is between P and Q . So, \overrightarrow{XP} and \overrightarrow{XQ} are opposite rays.



5. Name two pairs of opposite rays in the figure.



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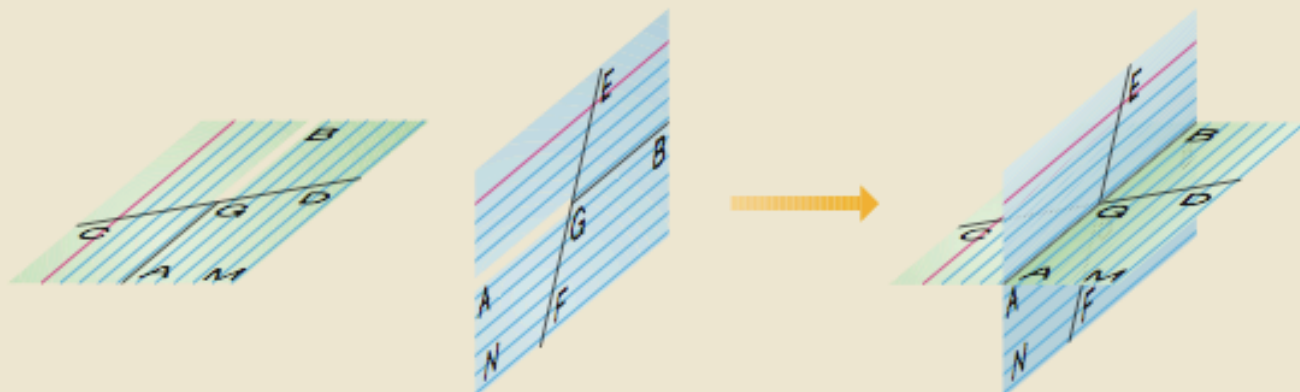
6. Draw and label four points so that three of them are collinear but all four of them are not collinear. Draw and name one segment and a pair of opposite rays.

ACTIVITY

**Developing
Concepts**

Modeling Intersections

Use two index cards. Label them as shown and cut slots halfway along each card.



1. What is the intersection of \overline{AB} and \overline{CD} ? of \overline{AB} and \overline{EF} ?
2. Slide the cards together. What is the intersection of \overline{CD} and \overline{EF} ?
3. What is the intersection of planes M and N ?
4. Are \overleftrightarrow{CD} and \overleftrightarrow{EF} coplanar? Explain.



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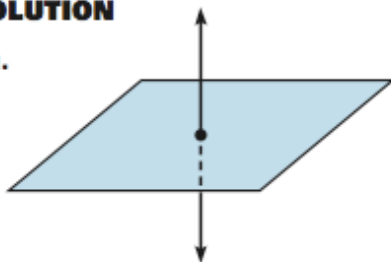
EXAMPLE 4 *Sketching Intersections*

Sketch the figure described.

- a. a line that intersects a plane in one point
- b. two planes that intersect in a line

SOLUTION

a.

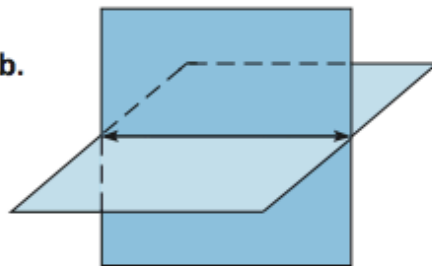


Draw a plane and a line.

Emphasize the point where they meet.

Dashes indicate where the line is hidden by the plane.

b.



Draw two planes.

Emphasize the line where they meet.

Dashes indicate where one plane is hidden by the other plane.

Sketch the figure described.

7. A line and a plane that do not intersect

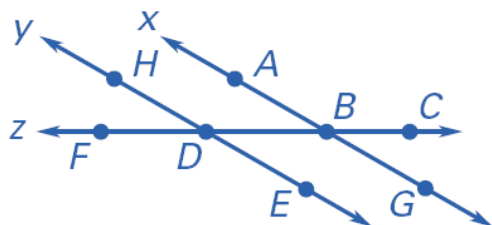
8. Two planes that do not intersect and a line that intersects each plane in one point.

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9. Sketch one plane with a line in the plane that intersects a line not in the plane.

10. _____ Name a point that is collinear to points F and D.



(A) E
(D) G

(B) B
(E) H

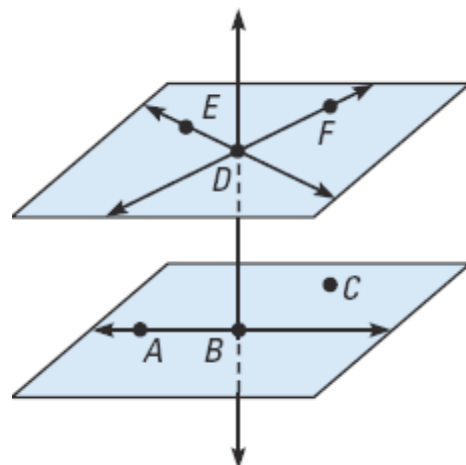
(C) A

11. Describe what each of these symbols means: \overline{PQ} , \overrightarrow{PQ} , \overleftrightarrow{PQ} , \overleftarrow{QP} .

Sketch a line that contains point R between points S and T. Decide if the following are true.

12. _____ \overline{ST} is the same as \overline{TS} .

13. _____ \overline{SR} is the same as \overline{RT} .



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True or False.

14. _____ \overleftrightarrow{RS} and \overleftrightarrow{RT} are opposite rays.

15. _____ \overleftrightarrow{ST} is the same as \overleftrightarrow{TS} .

16. _____ Point F lies on \overleftrightarrow{DE} .

17. _____ \overleftrightarrow{DE} lies on plane DEF.

18. _____ \overleftrightarrow{BD} and \overleftrightarrow{DE} intersect.

19. _____ \overleftrightarrow{DE} is the intersection of plane ABC and plane DEF.

